



**ADVANCED**  
General Certificate of Education  
2016

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**Chemistry**  
Assessment Unit A2 2  
*assessing*  
Analytical, Transition Metals, Electrochemistry  
and Further Organic Chemistry

**[AC222]**

**FRIDAY 10 JUNE, AFTERNOON**

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**MARK  
SCHEME**

## General Marking Instructions

### Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

### The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

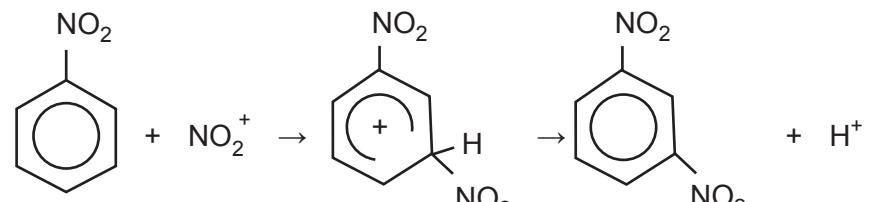
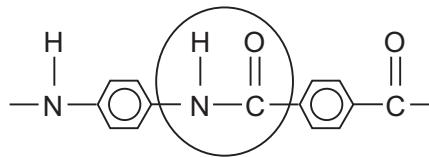
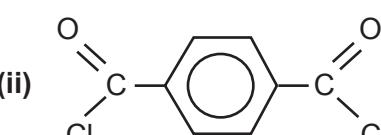
The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

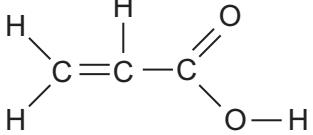
It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

<b>Section A</b>		<b>AVAILABLE MARKS</b>
<b>1</b>	D	
<b>2</b>	B	
<b>3</b>	A	
<b>4</b>	D	
<b>5</b>	B	
<b>6</b>	B	
<b>7</b>	C	
<b>8</b>	A	
<b>9</b>	A	
<b>10</b>	B	
[2] for each correct answer		<b>[20] 20</b>
<b>Section A</b>		<b>20</b>

Section B			AVAILABLE MARKS
11	silica/alumina $R_f$ /retardation factor or retention factor	nitrogen/helium/inert gas (not gas on its own) retention time/time	
			[4] 4
12 (a) (i)	$C_{12}H_9N_3O_4$ [1]	259 [1]	[2]
	(ii) number of moles of azo violet = $30/259 = 0.116$ $60\% \rightarrow 100\% 0.116/60 \times 100 = 0.193$ (1:1) number of moles of 4-nitrophenylamine = 0.193 mass of 4-nitrophenylamine = $0.193 \times 138 = 26.63$ g (units needed)	[3]	
(b) (i)	—N=N— circled		[1]
	(ii) extensive delocalisation (of electrons) and energy levels close together electrons excited/move to higher energy level removes a colour from light	[3]	
(c)	$O_2N-\text{C}_6\text{H}_4-\text{N} \equiv N$ (not $-\text{[N} \equiv \text{N]}^+$ )		[2]
(d) sodium nitrite			[1]
hydrochloric acid			[1]
<10 °C			[1] 14
13 (a)	Pt(s) or Platinum (solid)[1] $1 \text{ mol dm}^{-3} H^+$ [1] $1 \text{ mol dm}^{-3} Cu^{2+}$ [1] salt bridge [1]	[4]	
(b)	blue to yellow/brown	[2]	
(c) (i)	to neutralise (excess) $HNO_3$	[1]	
(ii)	$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$	[2]	
(iii)	starch [1] added when mixture is straw coloured [1]	[2]	
(iv)	blue-black to colourless	[1]	
(v)	number of moles of $S_2O_3^{2-} = (23.8 \times 0.1)/1000 = 0.00238$ (2:1) number of moles of $I_2$ in $25 \text{ cm}^3 = 0.00119$ number of moles of $I_2$ in $250 \text{ cm}^3 = 0.0119$ (1:2) number of moles of $Cu^{2+} = 0.0238$ mass of Cu = $0.0238 \times 64^* = 1.52$ g % Cu = $(1.52/2) \times 100 = 76.16\% / 76\%$ *Note that 63.5 can be used instead of 64	[4] 16	

		AVAILABLE MARKS
14 (a) (i) green-blue	[1]	
(ii) $\text{Cr(OH)}_3/\text{Cr(OH)}_3(\text{H}_2\text{O})_3/[(\text{Cr(OH)}_3(\text{H}_2\text{O})_3]$	[1]	
(b) green	[1]	
(c) (i) $[\text{Cr}(\text{en})_3]^{3+}$	[1]	
(ii) 6	[1]	
(d) hydrogen peroxide, potassium hydroxide (solution), (glacial) ethanoic acid	[3]	
(e) (i) ethanol [1] $<60^\circ\text{C}$ [1] sulfuric acid [1]	[3]	
(ii) $+6 \rightarrow +3$	[1]	12
15 (a) (i) concentrated sulfuric acid [1] concentrated nitric acid [1]	[2]	
(ii) nitronium ion [1] $2\text{H}_2\text{SO}_4 + \text{HNO}_3 \rightarrow \text{NO}_2^+ + 2\text{HSO}_4^- + \text{H}_3\text{O}^+$ [1]	[2]	
(iii)		
	[3]	
(iv) electrophilic [1] substitution [1]	[2]	
(b) (i) tin and concentrated hydrochloric acid [1] alkali/sodium hydroxide/potassium hydroxide [1]	[2]	
(ii) both have a lone pair of electrons on the nitrogen [1] that can bond to a hydrogen ion [1]	[2]	
(iii) aromatic ring is electron withdrawing making the lone pair of electrons on nitrogen less available	[1]	
(c) (i)		
	[2]	
(ii)		
	[1]	
(iii) contains an amide group/-CONH- [1] that can be hydrolysed by the action of microorganisms/bacteria [1]	[2]	19

		AVAILABLE MARKS
16	(a) A ligand which uses six lone pairs to form six coordinate bonds with a central metal atom or ion in a complex	[2]
(b) (i) 2 species → 7 species [1] increase in entropy [1]	[2]	
(ii) Select correct filter/appropriate wavelength [1] Prepare a range of samples consisting of different volumes/concentrations of $\text{Cu}^{2+}(\text{aq})$ and edta solution [1] Record the absorbance of each sample [1] Plot a graph of the results [1] Peak on graph indicates the mixture that is in the correct ratio [1]	[5]	
Quality of written communication	[2]	
(c) (i) $\text{CH}_3\text{COCH}_3 \rightarrow \text{CH}_2=\text{C=O} + \text{CH}_4$	[1]	
(ii) heterogeneous [1] different phases [1]	[2]	
(iii) reactants adsorb onto the surface [1] bonds weakened/broken in the reactants/orientation/closer together/lower activation energy [1] bonds form in products (and products are desorbed from the surface) [1]	[3]	17

17 (a) (i)		AVAILABLE MARKS
		[1]
(ii)	$\text{CH}_2=\text{CHCOONH}_4$	[1]
(iii)	ammonium propenoate	[1]
(b) (i)	$\text{P}_4\text{O}_{10}/\text{P}_2\text{O}_5$	[1]
(ii)	dehydration/elimination	[1]
(iii)	nmr spectrum of acrylamide has three peaks [1] nmr spectrum of acrylonitrile has two peaks [1] hence spectrum changes (completely) from 3 peaks to 2 peaks	[2]
(c)	hydrogen bonds [1] between lone pair of electrons on O of acrylamide and H of $\text{H}_2\text{O}$ (or between lone pair of electrons on O of $\text{H}_2\text{O}$ and H of $\text{NH}_2$ ) [1]	[2]
(d) (i)	orange solution decolourised	[1]
(ii)	$\text{CH}_2\text{CHCONH}_2 + \text{Br}_2 \rightarrow \text{CH}_2\text{BrCHBrCONH}_2$	[1]
(e) (i)	base peak [1] molecular ion peak [1]	[2]
(ii)	due to $^{13}\text{C}$	[1]
(iii)	$\text{CONH}_2^+$	[1]
(f)	$1.7 \times 10^{-4} \times 80 = 0.0136$ RMM of acrylamide = $3(12) + 5 + 14 + 16 = 71$ mass = $0.0136 \times 71 = 0.9656 \text{ g} = 965.6 \text{ mg}$	[3] 18
Section B		100
Total		120